

# Differences in crop selection, resource constraints, and crop use values among female- and male-headed smallholder households in Kenya, Tanzania, and Uganda

SPECIAL ISSUE: MORE THAN  
VALUE\$ IN THE FOOD SYSTEM



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## Abstract

A growing body of research suggests female- and male-headed households in low- and middle-income countries differ in terms of crop choices,

access to resources for growing different crops, and values placed on crops for home consumption versus market sale. To better understand relationships between gender of the household head, household resources, individual values, and crop choices, we draw on original survey data collected

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from 1,001 rural households in Kenya, Tanzania, and Uganda. Bivariate and multivariate analyses suggest that female-headed households are less likely to grow cash crops, reflecting a combination of resource constraints and social norms. However, on average, female-headed households plant more diverse food crops per hectare of land to which they have access, consistent with past findings suggesting crop diversity is a strategy employed by resource-constrained female-headed households to meet household food security needs. We also find that women surveyed on behalf of their households place a higher value on crops for food security, while men more frequently emphasize income potential. These results provide novel cross-country evidence on how female- and male-headed households, and women and men farmers within households, may prefer different crops and also face different levels of access to resources needed for market-oriented agriculture. Such findings support recent calls for development practitioners to carefully consider how market-oriented programs and policies may differentially affect female- and male-headed households and individuals residing within them. We also underscore the importance of collecting gender-disaggregated data to capture meaningful differences in preferences and constraints across women and men at the inter- and intra-household level.

### **Keywords**

Agrobiodiversity, Smallholder Farmers, Gender, Crop Selection, Commercialization, East Africa

### **Introduction**

Smallholder farmers worldwide, and especially in sub-Saharan Africa, are particularly vulnerable to poverty and food insecurity (Food and Agriculture Organization of the United Nations [FAO], UNICEF, WFP [World Food Program], & World Health Organization [WHO], 2019; IFAD, 2016; Niles & Salerno, 2018). Consequently, many development organizations have called for “pro-poor” agricultural development strategies, often centered on improving market access for smallholder farmers (Hellin, Lundy, & Meijer, 2009, p. 16; Horton, 2008). Such approaches suggest that market-oriented development strategies can effectively

address persistent rural poverty and food insecurity among diverse populations of smallholders operating in different social and agroecological contexts (Gengenbach, Schurman, Bassett, Munro, & Moseley, 2018; Pingali, 2015; Toenniessen, Adesina, & DeVries, 2008). To understand the applicability of these market-oriented approaches across different groups of smallholders, this paper investigates whether female-headed and male-headed smallholder farmer households in three countries in East Africa differ in terms of the crops they choose to grow, and the opportunities and constraints they face.

Some of the most marginalized and food insecure populations in sub-Saharan Africa are women smallholders (Koppmair, Kassie, & Qaim, 2017; Perez et al., 2015). Scholars and development organizations alike identify discrepancies in access to resources (e.g., land, agricultural inputs, credit) as key factors underlying production constraints and high rates of food insecurity among female-headed households (FAO, 2019; Peterman, Quisumbing, Berhman, & Nkonya, 2011; Quisumbing et al., 2014). Some advocate market interventions targeting female-headed households as a development priority (Rubin & Manfre, 2014). Gengenbach et al. (2018) note that market-oriented agricultural development approaches in Africa often focus on empowering female smallholders, as a means of increasing regional farm output and addressing household food and nutrition insecurity. However, they and several authors highlight limits of market-oriented interventions in promoting and achieving gender equity goals (Gengenbach et al., 2018; Meemken & Qaim, 2018; Tavenner et al., 2019).

Some observers raise a concern that too often policymakers and development experts assume that most households will respond similarly to policies and development interventions, overlooking important differences across and within households (Quisumbing et al. 2014). The preferences and constraints of female-headed smallholder farm households can be very different from those of male-headed households; relatedly, the preferences and constraints of individual women (within either female- or male-headed households) can also be very different from those of men (Doss, Kovarik,

Peterman, Quisumbing, & van den Bold, 2015; Doss, Meinzen-Dick, Quisumbing, & Theis, 2018). Such findings highlight a need to better understand how farm household livelihood choices, particularly those of female- and male-headed smallholder households, demonstrate different preferences and constraints across development contexts. A more nuanced understanding of differences in crop portfolios across household types, as well as differences in women's and men's individual crop choices within households, can inform development approaches in sub-Saharan African countries seeking to help households and individuals meet their goals and improve their wellbeing (Gengenbach et al., 2018).

In this paper, we use survey data from 1,001 smallholder farm households in East Africa to examine the degree to which female- and male-headed households differ in the number and variety of crops they grow, the land and market constraints they face, and their values around crops for food security versus market sale. Specifically, the objectives of this paper include:

- a) Describe the demographic profiles of female- and male-headed smallholder households in study communities in three countries—Kenya, Tanzania, and Uganda—where smallholder agriculture remains an important rural livelihood strategy, and rates of food and nutrition insecurity remain high (FAO et al., 2019; IFAD, 2016).
- b) Characterize the crop portfolios of female- and male-headed households in the sample, including the relative prevalence of food crops versus cash crops;
- c) Identify relationships between household characteristics, particularly the gender of the household head, and household crop portfolios;

- d) Establish whether relationships between gender and crop choices persist when accounting for differences in resource constraints among female- and male-headed households, with a specific focus on land access; and
- e) Determine whether female- and male-headed households differ in the importance that they place on the crops they grow primarily for home consumption versus the crops they grow for income.

Collectively, these objectives allow us to provide insights into if and how female- and male-headed households differ in their crop preferences and use, providing further understanding of how the gender of the household head relates to households' livelihood strategies. This analysis aims to contribute to broader scholarly debates around how different types of households are positioned to take advantage of market-oriented development approaches in sub-Saharan Africa. If the goal of enhancing market opportunities for smallholder women is to stimulate their competitiveness and empower them to transition out of poverty, then understanding what crops female-headed households grow and how they differ from male-headed households can help better align the assumptions of development theorists and practitioners with the realities of households' specific livelihood strategies.<sup>1</sup>

### Literature Review

Since the 1960s, scholars have underscored the importance of including women in development efforts and advancing gender equity (Singh, 2007). These ideas gained traction in the 2000s among major development organizations, including the World Bank, FAO, USAID, and the CGIAR Consortium. All these organizations emphasize the need to overcome barriers women face in the

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<sup>1</sup> Most of the data used in this study are at the household level. However, as we discuss in the literature review, we recognize there are important differences between household and individual characteristics, such that, for example, the preferences and constraints of male-headed households do not necessarily reflect those of the women who reside within those households (Quisumbing et al., 2014). Where possible, our analysis examines these differences empirically, including by asking how women and men *respondents* (including a large number of women responding on behalf of a male-headed household in our survey) differ in the importance that they place on the crops they grow.

agricultural sector in order to realize poverty alleviation and food security goals. Often these organizations' gender strategies have a substantial market focus. For example, the World Bank has outlined ten policy priorities to close the gender gap in African agriculture, with more than half focused on improving women's access to agricultural inputs (e.g., improved seed) or output markets (e.g., sales of high-value cash crops) (O'Sullivan, Rao, Banerjee, Gulati, & Vinez, 2014). Rubin and Manfre (2014) further highlighted the need to develop gender-equitable value chains (defined as all the activities and processes to bring a food product from conception to consumption and disposal) (Kaplinsky, 2000).

Developing competitive value chain opportunities for smallholders has become a hallmark strategy of major development organizations in sub-Saharan Africa (Gengenbach et al., 2018), with efforts focusing on a diverse array of crops from cassava leaves (Andersson, Lodin, & Chiwona-Karlton, 2016) and tea (Loconto, 2015) in Tanzania to pigeonpeas in Malawi (Me-Nsope & Larkins, 2016) and potatoes and sweet potatoes in Uganda (Horton et al., 2010). But empirical evidence consistently points to difficulties in changing existing dynamics among men and women in terms of control of resources and power relations across these varied value chains (Loconto, 2015; Malapit & Quisumbing, 2015; Meemken & Qaim, 2018; Rubin & Manfre, 2014). Research examining intra-household gender dynamics suggests that men and women can differ in their crop preferences and adoption of crop varieties. For example, although both men and women consider production traits such as yield when selecting crops, men more often emphasize commercial potential while women more often highlight food processing and preparation traits (Bentley et al., 2017; Christinck, Weltzien, Rattunde, & Ashby, 2017; Mudege & Walsh, 2016). In Kenya, Pincus, Croft, Roothaert, and Dubois (2018) note that women seed producers of indigenous vegetable varieties emphasize the importance of seed saving for household food security significantly more than men. At the household level, the gender of the household head also appears to influence crops grown and the

resulting livelihood outcomes. For example, Jones, Shrinivas, and Bezner-Kerr (2014) find that female-headed households in Malawi have a stronger association between higher crop diversity and household dietary diversity than male-headed households. Across Africa, women have been found to be key conservers of crop diversity (Amri & Kimaro, 2010; Wooten, 2003), although in some instances better access to land and other productive resources appear to facilitate a more diverse portfolio of crops for men than women (Nuijten, 2010).

Gengenbach et al. (2018) and others (Carr & Thompson, 2014; Jost et al., 2016; Quisumbing et al., 2014) recognize that gender intersects with an array of individual, institutional, and contextual factors in shaping crop choices across households. Teeken et al. (2018) demonstrate the complexity of these interactions when they find no differences across preferences of men and women cassava farmers for some traits (high yield, root size, early maturity, and dry matter content) regardless of the geographic region in Nigeria, but strong regional differences in the importance rankings of these traits, such that farmers in regions more oriented towards markets place higher importance on yield and early maturing, while farmers in regions with more focus on home consumption highlight cooking time to a greater degree. For other traits, the authors find significant differences between women and men producers (e.g., women prioritize cooking and processing traits while men emphasize agronomic traits) regardless of region. Similarly, Waldman, Ortega, Richardson, Clay, & Snapp (2016) conclude that gender is one among several variables, including income and geography, that determines the adoption of and preferences for legumes in Malawi. Differences in crop selection may also reflect institutional constraints limiting women's access to improved varieties, inputs, and information. In Uganda, Fisher and Carr (2015) find that men more commonly adopted drought-tolerant maize, due to differences in land, credit, and information access that better position men to invest in these crops. Zimmerer, Carney, and Vanek (2015) note that men's emphasis on market sales in some regions of Africa could reduce

women's access to land, cultivation of traditional crops, and maintenance of agrobiodiversity. In a large survey in Ethiopia, Kenya, and Tanzania, Tavenner et al. (2019) find that while greater on-farm crop and livestock diversity are associated with greater female control over resources, higher rates of commercialization are associated with more male control across all farming systems studied.

A recent review by Ampaire et al. (2019) concludes that although development efforts and agricultural policies in East Africa have increased awareness of gender differences, actual implementation has not addressed structural inequalities. Rather, the diverse and context-specific relationships between gender and agricultural production systems are often overlooked (Carr & Thompson, 2014). Furthermore, while a growing body of literature focuses on gendered differences related to crop selection—with findings consistently suggesting women's crop production is constrained by resource limitations—most studies are limited in geographical scope. By analyzing data across three East African countries using an identical survey instrument, this study provides comparable find-

ings across diverse study contexts. It thus adds to the base of empirical evidence needed to enhance context-specific understanding of gendered implications of market-centered agricultural development efforts.

## Materials and Methods

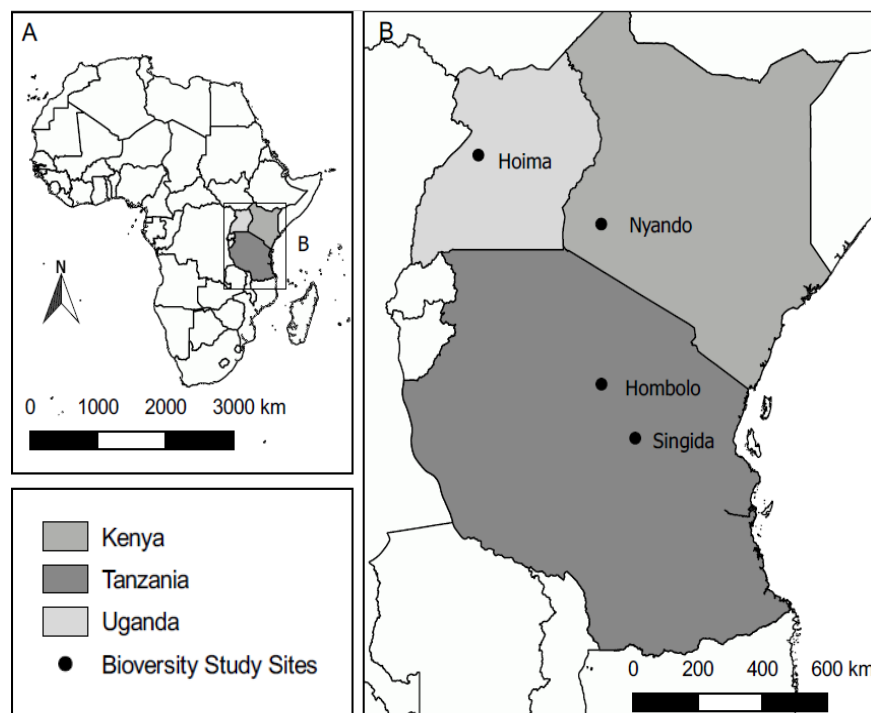
### *Site Description*

Eastern Africa has some of the highest rates of undernutrition and childhood stunting globally (FAO et al., 2019). Within the region, Kenya, Tanzania, and Uganda are ranked 87<sup>th</sup>, 98<sup>th</sup>, and 89<sup>th</sup> of 113 countries in overall national food security, respectively (The Economist Intelligence Unit, 2018). Case study countries and study sites were selected by the international agricultural research institute, Bioversity International, to be representative of the primary agroecological systems in the region, and include four sites: Nyando in Kenya; Hombolo and Singida in Tanzania; and Hoima in Uganda (Figure 1).

As in many other parts of sub-Saharan Africa, smallholder agriculture is the primary livelihood strategy for rural populations in the study areas.

And although there is high agricultural potential across all three countries, large yield gaps remain between that potential and what is actually produced. Policymakers and development practitioners have thus placed a strong emphasis on market-oriented development efforts. Between 2007 and 2016, all three countries were among the highest national recipients in terms of the number of grants provided by the Alliance for a Green Revolution in Africa [AGRA] (2017), and both Kenya and Uganda are Feed the Future countries with which the U.S. government partners to target food insecurity. Important regional staple crops have also been

**Figure 1. Study Communities in Kenya, Tanzania, and Uganda**



identified as holding potential for value chain development including maize, sweet potato, rice, sorghum, millet, beans, pigeonpeas, cassava, and groundnuts. Agricultural characteristics of the study sites are summarized in Table 1.

### *Sampling Design*

The research team adopted a snowball sampling approach common in network surveys (Sudman & Kalton, 1986), with researchers initially interviewing two nodal farmers,<sup>2</sup> a male and female, identified during focus group discussions in each village as having influence or leadership roles in their community. As part of the survey, farmers were asked whom they had either received seeds from or given seeds to—establishing the next cohort of farmers to interview. Participants were also asked to name the varieties of sorghum, millet, and bean seeds they had used in the last year and where they sourced the seed (e.g., local markets, research and extension services, private companies, or other farmers). Enumerators then surveyed farmers named by the first two respondents, and this sampling continued iteratively until interviewed farmers began mentioning the same names, or until no remaining farmers stated sourcing seed from others in the village.

The survey team then randomly selected a new set of interviewees in the next village and repeated the process until the target sample size was attained.

### *Data Collection*

Survey data were collected from July through October 2016 using the Open Data Kit (ODK) survey platform, which allows data to be immediately entered and coded using tablets on site.

The survey collected household-level data, including the gender of the household head, farmer age, educational attainment, sources of on- and off-farm income, and households' gender and age composition. Farm-level data included farm assets, total land area and area of cropland managed by the household, and the geographic location of the farm, including distance to the nearest paved road and distance to market. The network survey module also included sources of expert information and farmers' contact with experts and extension services.

At the crop level, survey data included the number and type of crops grown for 22 specific crops plus one "other crop" category. As shown in Table 2, we also consider the number of different food groups grown by each household, classified according to the household dietary diversity score (HDDS) defined by Kennedy et al. (2011) on behalf of the Food and Agriculture Organization of the United Nations (FAO). This food group diversity score ranges from 1 (household grew only one crop or a combination of crops all from one HDDS category) to 5 (household grew at least one each of Cereals, White roots/tubers, Legumes, Dark leafy vegetables, and Other vegetables or

**Table 1. Summary Information for the Study Sites in Kenya, Tanzania, and Uganda**

	Kenya		Tanzania		Uganda
	Nyando (Lower)	Nyando (Upper)	Hombolo	Singida	Hoima
<b>Farming system</b>	Mixed subsistence	Mixed subsistence to commercial	Mixed subsistence	Mixed subsistence	Mixed subsistence
<b>Agroecology</b>	Semi-arid / sub-humid	Sub-humid	Semi-arid	Semi-arid / Sub-humid	Sub-humid
<b>Average rainfall (mm)</b>	800	1220	400	600	1200
<b>Temperatures (degrees C.)</b>	18–34	12–30	12–35	12–30	12–32
<b>Altitude (m. above sea level)</b>	1100–1300	1200–1400	1100	1500	1120
<b>Market accessibility</b>	Very good	Very good	Poor	Moderate	Very good

<sup>2</sup> Nodal farmers are prominent farmers within a given community, expected to have a large number of connections with other farmers (i.e., to be "nodes" within a relatively large network).

fruits).<sup>3</sup> Finally, we further classify crops according to whether they are grown for primarily home consumption (i.e., staples) or if they are more typically grown for a combination of home consumption and market sale—including some commonly sold cereal crops, as well as higher-value vegetable, fruit, and other cash-crops (Table 2).

### Data Analysis

All statistical analyses were conducted in Stata 15.1. We first present basic descriptive statistics to summarize the demographic profiles of the households of survey respondents (objective a) and the crop portfolios of households according to the gender of the household head (objective b). We use independent samples t-tests, ANOVA, bivariate linear regression, or Pearson Chi-square tests for initial bivariate analyses considering the number

and type of crops grown by farmers as a function of farm and household characteristics. Then, to further examine relationships between household characteristics and crop selection with a focus on the gender of the household head (objective c), we use multivariate models including ordinary least squares (OLS) regression in the case of continuous outcome variables, or ordinal logistic regression in the case of ordered categorical response variables.

Our first outcome of interest is crop diversity—measured by the number of crops planted by the household ( $N_{crops}$ ). This is a simple sum of the number of different crops planted, a continuous variable ranging from 1 to 23. We hypothesize that female-headed households might plant fewer crops than male-headed households, due to a combination of resource constraints and gender norms that lead male-headed households to

**Table 2. Crop Classification by Household Dietary Diversity Score (HDDS) Categories and Common Local Usage**

HDDS Category	Crops	Primarily home consumption	Mixed consumption and market sale
Cereals	Maize		√
	Millet		√
	Rice		√
	Sorghum		√
White roots and tubers	Banana	√	[√ in Uganda]
	Cassava	√	[√ in Uganda]
	Sweet potato	√	[√ in Uganda]
Legumes	Beans		√
	Cowpea	√	
	Groundnut	√	
	Pigeonpea	√	
Dark green leafy vegetables	Dodo (Amaranth)	√	
	Sukuuma wiki (Collard greens)		√
	Nakati ( <i>Solanum aethiopioum</i> )		√
Other vegetables	Butternut	√	
	Cabbage		√
	Onion		√
	Pumpkin		√
	Tomato		√
Other fruits	Watermelon	√	
Other crops	Coffee		√
	Forages		√
	Other crops		√

Source: Household dietary diversity score (HDDS) categories from Kennedy, Ballard, and Dop (2011); crop uses are derived from author knowledge of the study area.

<sup>3</sup> We consider the category “Other crops” separately as these are less common in the sample and tend to be grown as cash crops (e.g., coffee) or are non-food (e.g., forages).



plant more relatively new crops—e.g., other vegetables, other fruits, and other crops (e.g., coffee) for market sale—at higher rates than female-headed households. The Model 1 regression takes the form:

$$N_{crops_i} = \beta_0 + \beta_1 x_{GenderHH_i} + \beta_2 x_{AgeHH_i} + \beta_3 x_{EducHH_i} + \beta_4 x_{OffFarmInc_i} + \beta_5 x_{AdultsHH_i} + \beta_6 x_{Dependency_i} + \beta_7 x_{Landholding_i} + \beta_8 x_{Distance\_market_i} + \beta_9 x_{Mobile_i} + \beta_{10} x_{Network_i} + \varepsilon_i$$

(Model 1–2)

Demographic variables hypothesized to relate to crop choices in addition to the gender of the household head (*GenderHH*) include the age of the household head (*AgeHH*), and the educational attainment of the household head (*EducHH*), an ordinal variable including four levels ranging from no education to completion of some secondary school or above. Access to off-farm income (*OffFarmInc*) is a binary variable coded as 1 if the household had access to any off-farm income sources. To control for on-farm family labor, we use two variables: the number of adults in the household (*AdultsHH*) and the dependency ratio (*Dependency*), defined as the percentage of dependents aged less than 15, or over 60 (Hadley, Belachew, Lindstrom, & Tessema, 2011) in the household. As both a measure of wealth and access to productive agricultural resources, we also include *Landholding* (hectares). *Distance to market* (kilometers) is included as a proxy for market access. Access to information and broader social capital is accounted for via two variables: ownership of a mobile phone (*Mobile*) and extent of social networks (*Network*), as measured by the number of other farmers from whom respondents received seed in the previous year. In Model 2 we further consider the number of different HDDS-based food crops ( $N_{hdds}$ ), ranging from 1 to 15, using the same regression model specification as Model 1 but focusing only on food crops traditionally grown in the study area.

In Model 3 we then consider aggregated HDDS food crop categories ( $N_{hdds\_cat}$ ) grown by the household, measured as a scale ranging from 1 to 5. We hypothesize that female-headed households

might be more likely to plant a more nutritionally diverse portfolio of crops—composed of at least one each of cereals, white roots/tubers, legumes, dark green leafy vegetables, and other vegetables and fruits—while male-headed households either specialize in certain food crops or allocate more resources to modern crops (including cash crops) rather than more diverse staples.

$$N_{hdds\_cat_i} = \beta_0 + \beta_1 x_{GenderHH_i} + \beta_2 x_{AgeHH_i} + \beta_3 x_{EducHH_i} + \beta_4 x_{OffFarmInc_i} + \beta_5 x_{AdultsHH_i} + \beta_6 x_{Dependency_i} + \beta_7 x_{Landholding_i} + \beta_8 x_{Distance\_market_i} + \beta_9 x_{Mobile_i} + \beta_{10} x_{Network_i} + \varepsilon_i$$

(Model 3)

Due to the limited number of possible values for the outcome variable  $N_{hdds\_cat}$ , we applied ordinal logistic regression models for Model 3. However, for ease of interpretation, we present OLS regression estimates, which yielded qualitatively similar findings to ordinal logistic regression methods.

We then seek to understand the degree to which the relationships between gender of the household head and crop choices identified in the above analyses hold when accounting for land access (objective d). In Model 4, we consider a revised dependent variable constructed to account for land constraints disproportionately shaping women's crop choices: the number of HDDS-based food categories grown per acre available land ( $N_{hdds\_cat}/landholding$ ). This is a continuous variable reflecting the diversity of food crops grown per unit of household land resources. We hypothesize that female-headed households might be relatively more likely than male-headed households to cultivate a more diverse portfolio of food crops after accounting for land resource constraints. Owing to the heavy right-skew of the variable, we use a log transformation in the OLS regression models:

$$\ln \left( \frac{N_{hdds\_cat}}{Landholding} \right) = \beta_0 + \beta_1 x_{GenderHH_i} + \beta_2 x_{AgeHH_i} + \beta_3 x_{EducHH_i} + \beta_4 x_{OffFarmInc_i} + \beta_5 x_{AdultsHH_i} + \beta_6 x_{Dependency_i} + \beta_7 x_{Landholding_i} + \beta_8 x_{Distance\_market_i} + \beta_9 x_{Mobile_i} + \beta_{10} x_{Network_i} + \varepsilon_i$$

(Model 4)



The land variable *Landholding* is omitted from the right-hand side of the equation to avoid multicollinearity for HDDS-based food categories grown per acre available land.

A final set of multivariate analyses (Models 5-8) focuses on objective e: whether female-headed households' crop choices reflect gendered preferences around crops primarily grown for household consumption and nutrition versus crops primarily grown for market sale. Namely, we compare rates of planting crops grown primarily for home consumption (Table 3) versus those grown for a combination of home consumption and market sale, including high-value vegetable, fruit, and other cash-crops (coffee, forages). These models are applied across female-headed and male-headed households in the sample using regression models identical to those previously used for food crops, but with the outcome variables total consumption crops grown ( $N_{consumption}$ ), and total mixed consumption and income crops grown ( $N_{mixed}$ ). We also model the logged outcome variables  $\ln(N_{consumption}/landholding)$  and  $\ln(N_{mixed}/landholding)$ —to consider the number of consumption crops grown per hectare of landholding, as well as the number of mixed consumption and income crops per hectare—to account for possible land constraints shaping crop choices.

Lastly, to further explore the degree to which differences in crop choices across female- and male-headed households might reflect different preferences regarding food crops versus income crops (objective e), we examine responses to two sets of survey questions. We asked respondents to report, for each crop planted among the 23 crops on the survey, the importance of that crop for (i) household food security, and (ii) household incomes. Enumerators collected responses on a 3-point Likert scale, with the categories “Not Important,” “Somewhat Important,” and “Very Important.” We hypothesize that due to social norms and resource constraints, female-headed households might be relatively more likely to assign high value to food security criteria when making choices about which crops to plant, while male-headed households might place more emphasis on income-generating potential.

### *Alternative Gender Measures and Limitations*

We acknowledge that a wealth of recent scholarship critiques the over-reliance of development research on the household as the unit of analysis, arguing that a unitary household model (i.e., assuming that the responses of the household head represent the interests of the household members) misses important power differentials within rural households (Anderson, Reynolds, & Gugerty, 2017; Quisumbing et al., 2014). As a result, measurements to account for women's empowerment and gender parity within female- and male-headed agricultural households have recently appeared and are being increasingly implemented (Larson, Castellanos, & Jensen, 2019; Malapit, Kovarik, Sproule, Meinzen-Dick, & Quisumbing, 2015). Our analysis relies on the household as the unit of analysis, with the respondent identifying the person in the household who serves as the head. Though we acknowledge this does not reveal dynamics within the household, it does provide insight into how the gender make-up of households may influence crop choices—and thus contributes to better understanding the complexities of gender and its effects on decision-making and resource allocation in rural agrarian contexts.

In addition, recognizing that preferences and priorities identified at the household level may obscure the perspectives of individuals residing within those households (Doss et al., 2018; Gengenbach et al., 2018; Quisumbing et al., 2014), in the final bivariate tests comparing rankings of relative importance assigned to the nutritional versus income values of the food and cash crops grown by gender of the household head, we further compare importance rankings by gender of the survey respondent. Although 67% of households in the sample had a male head-of-household, women provided responses for 41% of the male-headed households surveyed (responding on behalf of a male household head). In exploring how the responses of women in male-headed households might differ from male household heads' own self-reported importance ratings, we can begin to see how values around nutritional versus income benefits from crops might differ across genders (rather than across gender of the household head alone).

## Results

### *Objective a: Demographic profile of the sample*

Table 3 provides summary statistics disaggregated by country and gender of the household head. Roughly one-third of sampled households in each country are female-headed, ranging from 28% in Kenya to 36% in Tanzania. Female household heads are on average older than male household heads in Kenya ( $t=2.71$ ,  $p=0.004$ ), but this is not the case in Tanzania or Uganda. Consistent with national trends, female respondents in all countries have lower education rates; in Tanzania and Uganda, female-headed households are also less likely to have off-farm income ( $\chi^2 = 6.60$ ,  $p<0.010$ ). Female-headed households also generally have fewer adults present (except in Uganda) and have significantly fewer land resources in all three

countries ( $t = 5.09$ ,  $p<0.001$ ). Female-headed households are on average further away from markets, although this difference is only significant in Uganda ( $t = 1.55$ ,  $p<0.061$ ). In Kenya and Tanzania, female-headed households are also less likely to own a mobile phone ( $\chi^2 = 4.10$ ,  $p<0.043$ ). The extent of social networks—measured by the number of farmers from whom a household received seeds—varies across countries. Female-headed households reported more network ties than male-headed ones in Uganda ( $t=1.53$ ,  $p=0.064$ ), but there were no reported network differences across household types in Kenya or Tanzania.

### *Objective b: Household crop production by country and gender of the household head*

We next turn to descriptions of the crop produc-

**Table 3. Sample Descriptive Statistics by Country and Gender of the Household Head**

Gender of household head:	Kenya (n=364)		Tanzania (n=334)		Uganda (n=303)	
	Female (28%)	Male (72%)	Female (36%)	Male (64%)	Female (35%)	Male (65%)
<b>Age of head (%)</b>						
15–20	0	0	1.7	0.5	1.9	1.5
21–30	5.9	7.7	10.1	5.6	14.4	13.2
31–44	22.6	38.7	32.8	33.5	36.5	41.1
≥ 45	71.6	53.6	55.5	60.5	47.1	44.2
<b>Education of head (%)</b>						
None	25.5	7.3	39.5	21.9	17.9	11.2
Basic	22.6	26.3	19.3	14.9	26.4	25.9
Primary	34.3	24.8	37.0	54.4	33.0	35.0
Some secondary	16.7	36.6	2.5	6.1	21.7	25.9
Secondary or greater	1.0	5.0	1.7	2.8	1.0	2.0
<b>Off-farm income (yes=1)</b>	0.41	0.39	0.60	0.74	0.36	0.51
<b>Labor availability (mean)</b>						
Household members	5.90	6.42	5.28	6.51	6.55	6.10
Adult female	1.84	1.78	1.82	1.64	2.10	1.52
Adult male	1.67	1.98	1.37	1.95	1.48	1.69
<b>Dependents</b>	2.32	2.95	2.36	3.03	2.98	3.25
<b>Dependency ratio (% dep)</b>	43.8	47.3	45.1	45.6	44.6	50.2
<b>Landholding (mean acres)</b>	5.58	6.25	5.14	8.08	5.57	6.94
<b>Cropland (mean acres)</b>	2.32	2.47	4.28	6.58	3.53	5.41
<b>Distance to market (mean km)</b>	10.18	9.07	3.65	3.57	4.74	4.11
<b>Mobile phone (yes=1)</b>	0.79	0.90	0.61	0.71	0.86	0.90
<b>Network ties (mean)<sup>a</sup></b>	0.66	0.73	0.79	0.82	0.59	0.46

<sup>a</sup> Network ties represent the number of other farmers from whom the respondent received seed (including zero for farmers receiving no seed from others), in the network module of the survey.

tion of the households in the sample across genders (gender of the household head) and countries. We summarize households' crop portfolios in several ways, beginning with a basic count of the number of species grown, followed by the percentage of households that grow each kind of crop. We then proceed to a breakdown of crop production according to HDDS food crop categories.

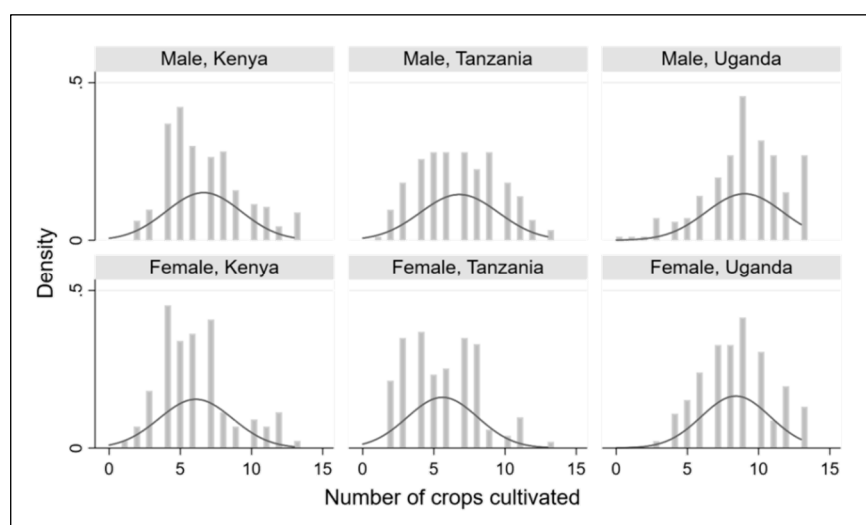
As shown in Figure 2 and consistent with past findings from the region (Tavenner et al., 2019), both female- and male-headed households in the sample overwhelmingly plant multiple crops. On average, male-headed households plant more crops overall: in bivariate t-tests having a female head is associated with 0.55 fewer crops planted in Kenya ( $t=1.79, p=0.037$ ), 1.19 fewer crops in Tanzania ( $t=3.91, p<0.001$ ), and 0.61 fewer crops in Uganda ( $t=1.95, p=0.026$ ).<sup>4</sup>

Table 4 shows the frequencies with which female- versus male-headed households grew specific food crops in each country. Differences in crop portfolios are apparent across countries, reflecting regional agroecologies, cultural food preferences, and/or local market demand. These differences are also reflected across genders within countries, possibly reflecting gender norms and

differences in resource access. Among grain crops, maize is the most commonly grown in all households and countries. Sorghum is common in Kenya, relatively uncommon in Uganda, and somewhat common in Tanzania, but more so among male-headed households. Millet is grown by roughly one-third of female- and male-headed households in Kenya but less so in Tanzania or Uganda. Though relatively uncommon for respondents in all countries, rice is most likely to be grown by male-headed households in Tanzania or Uganda. Among the remaining food crops, several others are also more likely to be found in male-headed households including cowpea, cabbage, pumpkin, and tomato in all countries, as well as groundnut, pigeonpea, and sweet potato in Tanzania, sukuma wiki (collard greens) in Kenya, and nakati (*Solanum aethiopicum*) in Uganda. Such patterns may reflect many of these crops being considered to be more “men’s crops” than “women’s crops” in these country contexts—indeed the only crop substantially more common in female-headed households is groundnut in Uganda (grown by 84.9% of female-headed households versus 73.6% of male-headed).

However, in any categorization of “women’s crops” versus “men’s crops,” it should be noted that within any given household, both women and men may participate in crop production. For example, Nakazi et al. (2017) describe how both men and women in Uganda widely contribute to the production of beans, even though this has traditionally been identified as a “women’s crop.” Relatedly, “women’s crops” may be cultivated by women within male-headed households and vice versa. Thus, the household-level summary findings we present

**Figure 2. Number of Crops Grown by Sample Households**



<sup>4</sup> In Kenya the median count of crops per household was 6 in both female- and male-headed households. In Tanzania and Uganda the median male-headed households planted more crops than female-headed, with a median of 7 (male) versus 6 (female) in Tanzania, and a median of 9 (male) versus 8 (female) in Uganda.

**Table 4. Food Crops Grown, Percent of Households by Country and Gender of the Household Head**

Category	Crop	Kenya (n=364)		Tanzania (n=334)		Uganda (n=303)	
		Female	Male	Female	Male	Female	Male
<b>Cereals</b>	Maize	97.1	96.9	94.1	92.6	92.5	89.8
	Sorghum	90.1	92.7	67.2	76.7	13.2	15.7
	Millet	31.3	37.4	16.8	17.7	17.9	16.2
	Rice	1.0	0.4	6.7	12.6	9.4	19.8
<b>Legumes</b>	Bean	81.4	86.2	47.9	43.3	100.0	97.8
	Groundnut	33.3	30.9	68.9	78.6	84.9	73.6
	Cowpea	56.9	64.8	47.9	54.0	25.5	33.0
	Pigeonpea	7.8	8.0	11.8	29.3	32.1	36.5
<b>White starch</b>	Sweet potato	27.4	26.7	10.1	19.5	94.3	93.9
	Cassava	25.5	23.3	4.2	8.8	96.2	95.4
	Banana	30.4	35.9	2.5	2.8	79.2	76.1
<b>Dark green</b>	Dodo	13.7	16.0	12.6	15.8	69.8	68.0
	Sukuma wiki	20.6	37.0	0	4.7	1.9	4.7
	Nakati	16.7	17.5	16.8	24.7	47.2	62.9
<b>Other vegetables</b>	Butternut	2.9	6.9	27.7	33.5	0	0
	Cabbage	9.9	13.7	1.7	4.7	4.7	10.7
	Onion	25.5	27.1	2.5	3.3	4.7	9.6
	Pumpkin	21.6	26.7	48.7	60.9	17.0	25.8
	Tomato	18.6	20.6	5.9	15.8	8.5	13.7

may mask individual-level differences in cropping choices across genders within households (a distinction we revisit below).

When considering the aggregated HDDS food crop categories, for cereals, white starches, and legumes, we find little variation on average across female- and male-headed households in the sample—both appear equally likely to grow at least one cereal, white starch, or legume within a given

country context (Table 5). In Uganda, more than 94% of both female- and male-headed households grow at least one cereal *and* at least one white starch and legume. In Kenya and Tanzania, white starches are less common overall. Dark green vegetables are most commonly grown in Uganda, followed by Kenya, and more common among male-headed households in all three countries.

Some of the most striking differences across

**Table 5. Crop Categories Grown, Percent of Households by Country and Gender of the Household Head**

Crop	Kenya (n=364)		Tanzania (n=334)		Uganda (n=303)	
	Female	Male	Female	Male	Female	Male
<b>Cereals (any)</b>	99.0	100	99.2	99.1	93.4	93.9
<b>White roots and tubers (any)</b>	52.9	56.9	15.1	23.7	98.1	97.5
<b>Legumes (any)</b>	98.0	97.7	97.5	94.4	100	98.5
<b>Dark green leafy veg (any)</b>	36.3	49.2	20.2	32.6	71.7	77.2
<b>Other vegetables</b>	37.3	47.3	52.1	66.0	23.6	39.6
<b>Other fruits</b>	2.9	6.5	25.2	32.6	0	2.5
<b>Other crops</b>	4.9	5.0	41.2	50.7	2.8	9.6
<b>Coffee</b>	1.0	0.8	0	0	47.2	59.9
<b>Forages</b>	10.8	15.3	2.5	5.6	1.9	1.5

household types in Table 5 are for crops commonly grown for market. Male-headed households are more likely to grow other vegetables (including various horticulture cash crops) across all study sites. In Uganda, male-headed households appear more likely to grow other fruits and other crops at much higher rates than female-headed households. Among sampled households in Uganda, where coffee cultivation is relatively more common, coffee is grown by nearly 60% of male-headed households—but only 47.2% of female-headed households. In Kenya, forages are more commonly grown than coffee, but are again more common among male-headed households. In aggregate, we see strong evidence of diverse cropping portfolios across countries and household types, with male-headed households overall more likely to plant several key food and cash crops.

*Objective c: Relationships between household characteristics and crop production*

Our analysis proceeds to consider relationships between a household's characteristics and crop production, with a focus on the gender of the household head. In multivariate models for the total number of crops grown by households, we again see female-headed households on average grow significantly fewer crops than male-headed ones, even after controlling for a range of other individual and household characteristics (Table 6). Across all households in the sample, older household heads and those with more education grow more crops on average, as do those with access to off-farm income and larger landholdings. Access to a broader social network of other farmers is also associated with a larger number of crops planted (though the causal direction for this relationship is

**Table 6. Correlates of the Total Number of Crops Grown (OLS Regression Models)**

	Model 1: N <sub>crops</sub>		
	All Households	Female-headed	Male-headed
Household head gender (female)	-0.352*	—	—
Age	Young adult (15-30 years)	—	—
	Middle-age adult (31-45 years)	0.435	0.240
	Elder (>45 years)	0.757**	0.847*
Education	None	—	—
	Basic education	0.502*	0.705*
	Completed primary school	0.484*	-0.031
	Some secondary school	0.617**	0.390
	Beyond secondary school	0.847	1.118
Farm / Household	Off-farm income	1.094***	1.518***
	Adults in household	0.012	0.118*
	Percent dependents	0.344	0.158
	Landholding	0.131***	0.094***
	Distance to market	-0.019	-0.047
	Mobile phone	0.128	0.149
	Network ties	0.319***	0.074
Site	Kenya	—	—
	Tanzania	-0.488**	-0.786*
	Uganda	2.326***	2.288***
	Constant	4.259***	3.870***
	Valid N	927	305
	Adjusted R <sup>2</sup>	0.260	0.281
			0.240

ambiguous). Finally, we see significant differences across the three countries even after controlling for household characteristics, with more crops planted per household in Uganda, and fewer in Tanzania (relative to the reference country Kenya).

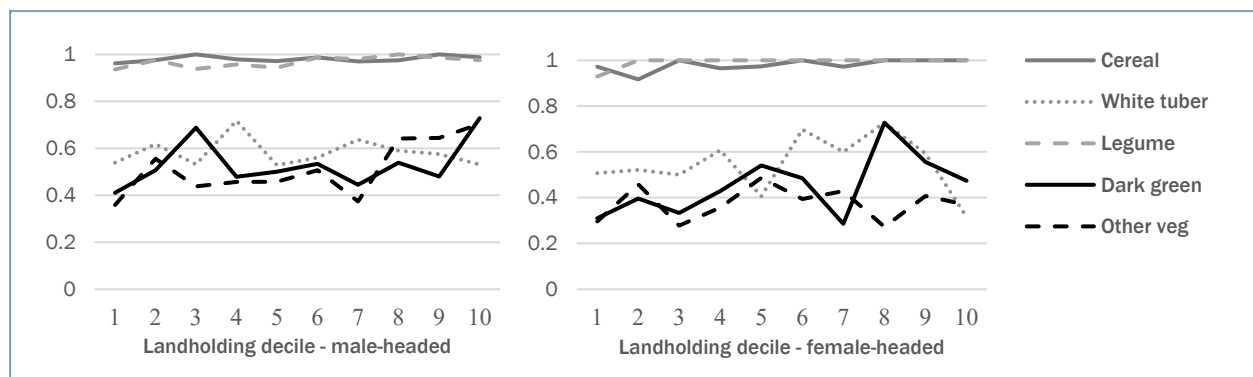
The gender-disaggregated regression models in Table 6 further suggest that female-headed and male-headed households in the sample face different constraints on the number of crops they grow. Age, for example, is significantly positively associated with the number of crops grown in female-headed households, but not in male-headed households. Education, meanwhile, is positively associated with the number of crops planted by male-headed households, but less so among female-headed (perhaps because constraints other than education weigh relatively more heavily on female-headed households). Both female- and male-headed households plant more crops when they have access to off-farm income, possibly reflecting market access for more diversified crop portfolios. Both female- and male-headed households also plant more crops when they have access to more landholdings—although for female-headed households, access to labor (as measured by the number of adults in the household) is also a strong predictor of the number of crops grown, while male-headed households appear less responsive to family labor availability. This last finding may reflect male-headed households on average having more labor available than female-headed households (and hence potentially seeing diminishing marginal returns to additional labor). This difference in responsiveness to labor availability may

also be due to male-headed households' relatively greater orientation towards diversified commercial crop production (regardless of available labor).

*Objective d: The moderating effect of land access on relationships between household characteristics and food crop production*

Given that resource constraints have been found to disproportionately affect production decisions among women smallholders (Quisumbing et al., 2014), we next seek to assess further how land availability might moderate relationships between gender of the household head and crop planting. As shown in Figure 3, landholding is significantly associated with the number of HDDS food crops planted among sample households (for the moment excluding cash crops such as coffee and forages). In simple bivariate tests, an additional hectare of landholding is associated with an additional 0.14 food crops in male-headed households ( $F(1,672)=46.36, p<0.001$ ) and an additional 0.12 crops in female-headed households ( $F(1,325)=10.79, p<0.001$ ) across the full sample. In female-headed households having more than the median landholding is strongly associated with more food crop diversity, with women in the eighth or ninth decile of landholding most likely to grow four of the five HDDS food crop groups considered here. Households in the bottom decile of landholding grow the fewest different food groups across household types. Among both female- and male-headed households, however, we also see a decline in the cultivation of white roots and tubers at higher levels of landholding,

**Figure 3. Proportion of Households Growing Food Crop Groups, by Deciles of Landholding**



suggesting less food crop diversity with greater landholdings among at least some households.

Multivariate models for the total number of HDDS food groups grown by households in the sample are shown in Table 7. While the previous regression in Table 6 suggests female-headed households on average plant fewer crops than male-headed households, in Model 2 in Table 7, we see no significant differences across female- and male-headed households in terms of the number of HDDS food crops planted. Rather, higher levels of education, access to off-farm income, greater landholding, and greater social network ties are the household attributes more consistently associated with the number of food crops grown. In Model 3, we do find a small negative association between gender of the household head and the number of aggregated HDDS food categories grown, with female-headed households on average planting

0.152 fewer HDDS food groups than male-headed households ( $p=0.029$ ). But in Model 4 we find a strong *positive* association between female household heads and the number of HDDS food crop categories planted per hectare of land available to them—suggesting that, after accounting for land resource constraints, female-headed households may be more likely to plant a diverse portfolio of food crops than male-headed households. On average female-headed households in the sample plant 17.5% more HDDS food crop categories per available hectare of land than male-headed households ( $\text{Exp}(\beta)=1.175, p<0.001$ ). Significant cross-country differences remain in all models.

*Objective e: The importance of crops for market and home consumption among female- and male-headed households*

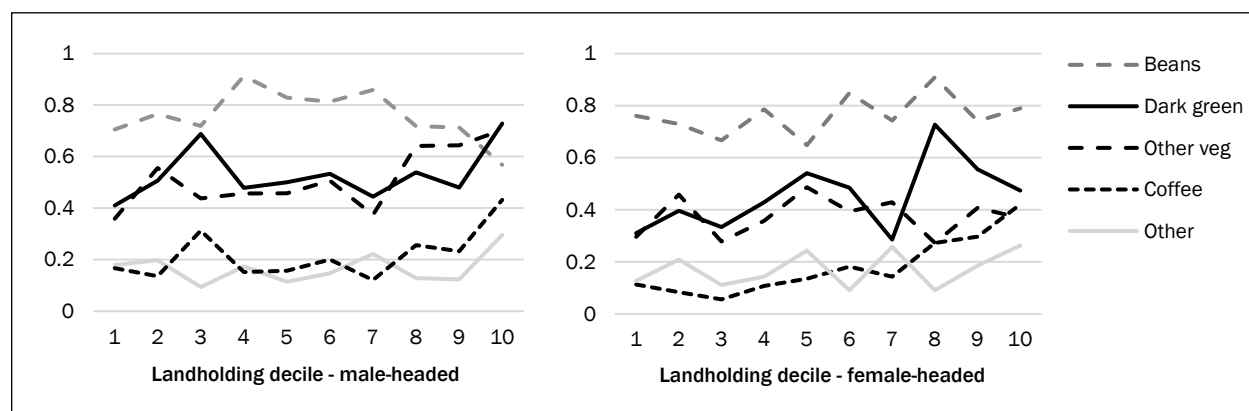
Our final set of regression analyses explores if and

**Table 7. Correlates of the Number of HDDS Food Crops (hdds\_crops) and the Number of Different Food Groups (hdds\_cat) Grown, Both Overall and Per Hectare of Landholding**

	Model 2: N <sub>hdds_crops</sub>	Model 3: N <sub>hdds_cat</sub>	Model 4: ln(N <sub>hdds_cat</sub> / Landholding)
	B	B	Exp(β)
Household head gender (female)	-0.284	-0.152**	1.175***
Age	—	—	—
	Young adult (15-30 years)	—	—
	Middle age adult (31-45 years)	0.057	0.895
	Elder (>45 years)	0.160	0.828**
Education	None	—	—
	Basic education	0.579**	1.295***
	Completed primary school	0.614**	1.135*
	Some secondary school	0.753***	1.108
	Beyond secondary school	1.122**	1.237
Farm / Household	Off-farm income	0.880***	0.998
	Adults in the household	0.018	0.968***
	Percent dependents	0.198	0.913
	Landholding	0.130***	—
	Distance to market	-0.015	0.990**
	Mobile phone	0.176	0.840**
	Network ties	0.343***	1.027
Site	Kenya	—	—
	Tanzania	-0.807***	0.818***
	Uganda	1.895***	1.124*
	Constant	4.150***	0.786
	Valid N	927	922
	Adjusted R <sup>2</sup>	0.237	0.067



**Figure 4. Proportion of Households Growing Income Crop Groups, by Deciles of Landholding**



how female- and male-headed households value crops for home consumption versus for market sale differently. As with crops grown for food security, access to land remains a key constraint on the number of income crops planted by both household types (using consumption versus mixed consumption and income crop groupings shown in Table 3). Male-headed households appear more likely to allocate land to income crops. As shown in Figure 4, across almost all landholding deciles, male-headed households are more likely to grow income crops than female-headed households. Among both female- and male-headed households, those in the lowest (bottom decile) of landholding grow the fewest different income crops. However, female-headed households with limited landholding are much less likely to grow income crops than their male-headed counterparts. Bivariate tests suggest that, on average, an additional hectare of landholding is associated with an additional 0.08 income crops in male-headed households versus an additional 0.04 in female-headed households ( $p < 0.001$ ).

In multivariate models for the total number of consumption crops versus mixed consumption and income crop groups grown, we again find a significant negative association between the household head being female and the number of crops grown, but only for more market-oriented crops (Table 8). In Model 5, female-headed households are no less likely than male-headed households to grow larger numbers of food crops primarily for consumption, but in Model 6, female-headed households appear

less likely to plant additional income crops. After accounting for landholding, in Model 7, female-headed households are more likely to plant greater numbers of consumption crops on a given area of land, but not more likely than male-headed households to plant greater numbers of mixed consumption and income crops. Taken together, Models 5 through 8 suggest that given the same amount of land and other resources, female-headed households plant more crops for home-consumption, while male-headed households are relatively more likely to plant crops for mixed consumption and income. In all models, socioeconomic variables relating to education, off-farm income, land resources, market access, and social networks are the predictors most consistently associated with increased planting of mixed consumption-income crops. Again significant differences across countries remain after controlling for farm and household characteristics.

#### *Extension: Female and male individual perspectives on crop contributions to food security and household incomes*

Given the prominent differences in crop choices among female- and male-headed households observed through both bivariate and multivariate analyses, especially between crops typically consumed as food versus crops used for a mix of consumption and market sale, we further examined two survey questions that specifically asked respondents to report their perspectives on the food security importance of different crops, and

**Table 8. Correlates of Staple Food Versus Mixed Food-Income Crops Grown**

	Model 5: N <sub>consumption</sub>	Model 6: N <sub>mixed</sub>	Model 7: ln(N <sub>consumption</sub> / Landholding)	Model 8: ln(N <sub>mixed</sub> / Landholding)
	$\beta$	$\beta$	Exp( $\beta$ )	Exp( $\beta$ )
Household head gender (female)	-0.050	-0.312***	1.051**	1.039
Age				
	Young adult (15-30 years)	—	—	—
	Middle age adult (31-45 years)	0.487***	1.071*	0.926*
	Elder (>45 years)	0.833***	1.101**	0.896***
Education	None	—	—	—
	Basic education	0.192	0.409**	1.120***
	Completed primary school	0.472***	0.069	1.038
	Some secondary school	0.665***	0.075	1.011
	Beyond secondary school	0.690**	0.976*	1.141*
Farm / Household	Off-farm income	0.728***	0.351***	1.059**
	Adults in the household	-0.002	0.027	0.989***
	Percent dependents	0.237	0.055	0.997
	Landholding	0.048***	0.115***	—
	Distance to market	0.002	-0.016*	0.997
	Mobile phone	0.002	0.068	0.953
	Network ties	0.143**	0.251***	1.031**
Site	Kenya	—	—	—
	Tanzania	0.208	-1.101***	1.016
	Uganda	2.742***	0.031	1.432***
	Constant	0.364	4.264***	1.506***
Valid N	927	927	923	923
Adjusted R <sup>2</sup>	0.414	0.169	0.198	0.044

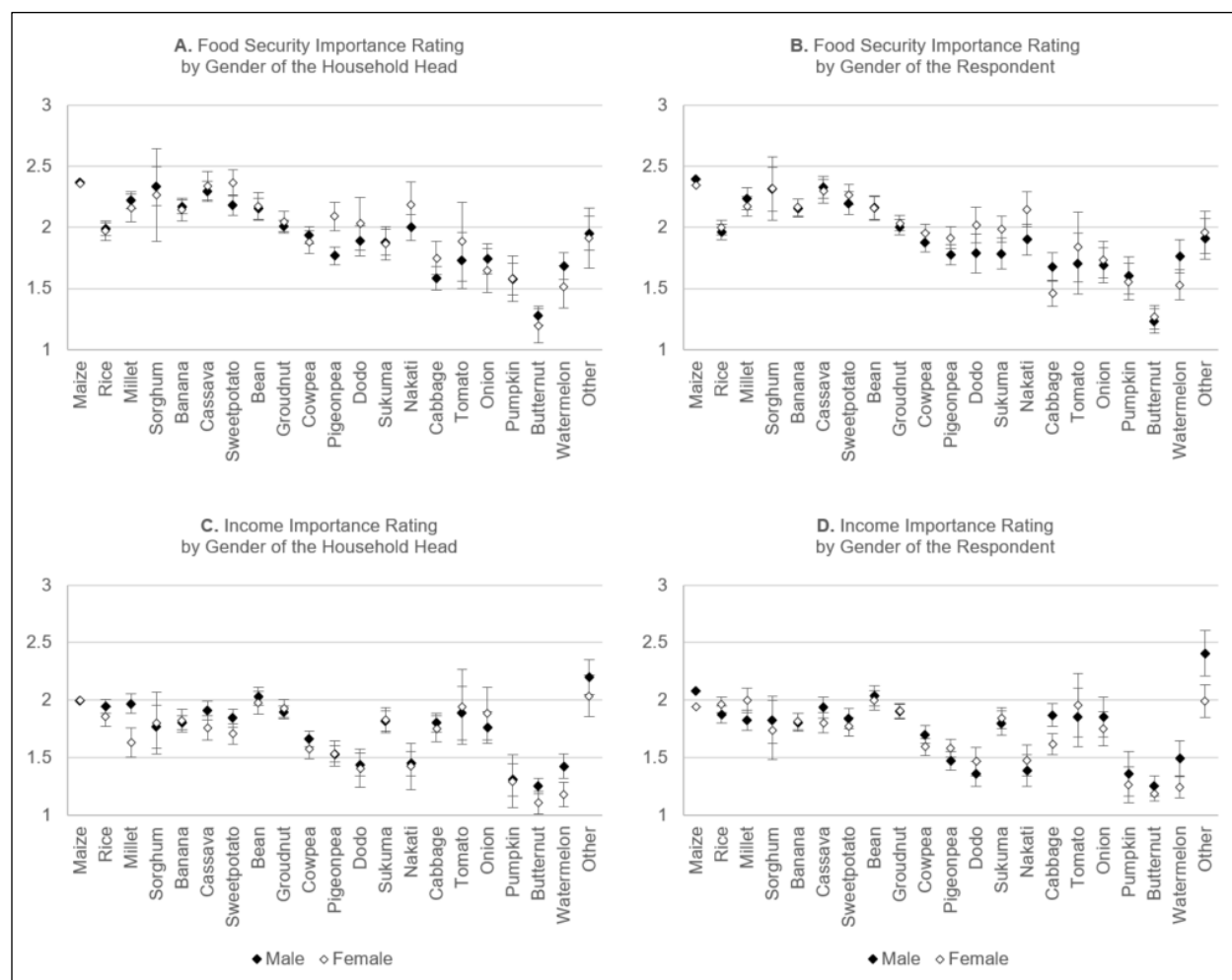
the income security importance of these same crops, as summarized in Figure 5. Owing to the way these questions were asked—i.e., asking respondents to state their perception of the importance of each crop to the household in terms of food security and income—we can disaggregate responses by gender of the household head (67% male and 33% female in the sample), but also by gender of the survey *respondent* (41% male and 59% female in the sample, with 41% of male-headed households represented in the survey by a female respondent). While the former allows us to examine differences in gendered preferences around crops at the household level (Figures 5A and 5C), the latter provides insights into individual preferences by respondent gender (Figures 5B and 5D).

Two key findings emerge from these summary responses. First, we see relatively few statistically significant differences in food security importance

scores or income importance scores when splitting responses by gender of the household head (Figure 5A and 5C). However, the pattern is broadly consistent with expectations: female-headed households appear to emphasize the food security value of crops more than male-headed, and male-headed households are more likely to emphasize income importance of the crops than female-headed households. With limited exceptions, however, female-headed and male-headed households appear to exhibit similar attitudes around the relative importance of different crops for food and income security.

Second, however, we also find that estimates of perceptions of the importance of crops for food and income security appear to depend, at least in part, on how gender is analyzed (gender of the *household head*, or gender of the *respondent*). When dividing the same survey responses by gender of

**Figure 5. Importance of Different Crops for Household Food Security and Incomes, by Gender of the Household Head and by Gender of the Survey Respondent**



the survey respondent (Figure 5B and 5D), several more significant differences in responses emerge. Women assign higher food security importance than men for a range of traditional food crops, including cowpea, pigeonpea, dodo, sukuma wiki, and nakati, and less food security importance than men for cash crops like cabbage and watermelon. Country-specific findings (shown in Appendix A) reveal even more striking differences—suggesting that women in female-headed households may see certain crops as food security crops, while women in male-headed households are more likely to see them as income-generating crops.

When comparing responses to the question about the importance of each crop for household income, contrary to expectations that gender

norms might lead male-headed households to assign a higher value to the income potential of different crops, we see relatively few significant differences in terms of income importance ratings given to crops by female- versus male-headed households. However, considering the gender of respondents rather than the gender of household heads, women *respondents* in the sample on average see less income value in a range of crops than men, including maize, cabbage, watermelon, and other crops—perhaps reflecting gendered differences in access to the income from commercialization of these crops among women in male-headed households. Country-specific results in Appendix A again show that the way gender is captured—either looking at the gender of the household head or the

gender of the individual respondent—has important implications for which crops appear most important for food and income security among women smallholders.

## Discussion

This study draws on a detailed original dataset applying an identical survey instrument across rural communities in three countries to explore how the gender composition of smallholder households in East Africa relates to their cropping choices. Building on many previous studies of gender and smallholder decision-making using a range of methods in a variety of contexts (Amri & Kimaro, 2010; Anderson et al., 2017; Bentley et al., 2017; Fisher & Carr, 2015; Me-Nsope & Larkins, 2016; Nuijten, 2010; Pincus et al., 2018; Teeken et al., 2018), our analysis provides two key findings: female-headed households that generally have less access to land and other resources are more likely to diversify their food crop production than male-headed households, and that gender must be considered alongside other variables such as country context and socioeconomic status to more comprehensively understand decisions around crop cultivation.

Results from this analysis of cropping patterns and preferences among female- and male-headed households in Kenya, Tanzania, and Uganda suggest that while female-headed households grow fewer crops overall than male-headed households, the story is more complex after accounting for crop type (food versus income) alongside land resource constraints that disproportionately affect female-headed households. Consistent with previous literature (Teeken et al., 2018; Tobin, Jones, & Thiede, 2019; Waldman et al., 2016), crop choices generally reflect regional crop preferences, likely resulting from a combination of agroecological suitability, cultural preferences, market access, and/or local demand, shaping the common agricultural practices among smallholders in the study countries. However, we also see significant differences in crop choices according to the gender of the household head. In addition to the general trend of male-headed households cultivating more crops overall, we see a higher percentage of male-headed households cultivating both crops that are

generally used for home consumption (cowpea and banana in Kenya, sorghum and sweet potato in Tanzania, rice and cowpea in Uganda), as well as market-oriented crops where for most crop categories male-headed households are more likely to be producers of crops for market sale. While the tendency for male-headed households to produce more commercially-oriented crops is expected based on previous findings (Bentley et al., 2017; Christinck et al., 2017; Mudege & Walsh, 2016), they also produce subsistence crops at higher frequencies in our sample, which appears to contrast with the notion that female-headed households more commonly emphasize crops for home consumption (Pincus et al., 2018).

Furthermore, despite the general global trend of women being important keepers of agrobiodiversity (Howard, 2003; Zimmerer et al., 2015), our findings suggest that male-headed households are significantly more likely to grow a larger variety of crops. We hypothesize—though cannot test with these data—that male-headed households’ production of both subsistence crops and more diverse crop portfolios at higher rates than female-headed households may in part be a reflection of both resource access as well as intra-household dynamics in which women who reside in male-headed households are also exerting some decision-making power over cropping choices (or, in other cases, in which women in male-headed households are expected to grow “women’s crops” to meet family needs). In other words, the relatively greater diversity of crop portfolios in male-headed households may reflect a combination of male-headed households’ historically greater resource and market access as well as both men’s and women’s crop preferences.

These findings become even more nuanced when we consider female- versus male-headed households’ relative access to key productive resources like land. Multivariate regression results suggest female-headed households grow more HDDS food groups per unit of land available than their male-headed household counterparts. Past research suggests that when faced with resource constraints, female-headed households may be more likely to utilize crop diversity as a strategy to meet livelihood needs (FAO, 2019; Quisumbing et

al., 2014). This pattern is reflected in our findings, which suggest in the face of limited market access and disproportionate land resource constraints, female-headed households emphasize food crops for home consumption, and plant more diverse portfolios of food crops, compared to male-headed ones (Pincus et al., 2018; Tavenner et al., 2019). Though our findings do not allow for deeper explanations of whether food crop diversification among female-headed households occurs out of necessity due to resource barriers or because of a greater valuation of agrobiodiversity, we provide some preliminary evidence that women farmers—whether in female-headed or male-headed households—do place a greater value on the food security importance of crops, and less on the income importance, than their male counterparts in Kenya, Tanzania, and Uganda.

Situating these findings within the context of current research, policies, and programs advocating market-oriented development approaches in sub-Saharan Africa, our study joins others who have called for caution in assuming that a focus on more market opportunities will necessarily spur improvements in wellbeing among female-headed smallholder households. The findings in this study suggest that female-headed households who are constrained in their land access are more likely to use alternative strategies like crop diversification for home consumption rather than crop specialization for market sale. If they do not have the resources, including sufficient land to meet the demands of newly accessible markets, then growing markets may do little to benefit many female-headed households. Following the insights of previous work (Peterman et al., 2011; Quisumbing et al., 2014), our study contributes to the growing evidence base that alleviating gendered barriers to access to resources such as land may be a necessary prerequisite to the success of development interventions pursuing market-oriented approaches.


Importantly, however, our findings are also in line with previous research emphasizing that gender constitutes just one of the many factors intersecting to explain varying outcomes among smallholders (Gengenbach et al., 2018; Loconto, 2015; Quisumbing et al., 2014). When considering correlates of on-farm crop diversity (number of

HDDS food groups grown) while controlling for gender and land availability, we find household heads' age, educational status, off-farm income sources, and social networks are all significant predictors. Younger households and those with low educational status might grow a more diverse range of crops because few other options exist, while households with an array of income sources, higher educational status, and more social ties may grow multiple crops to diversify further their portfolio of livelihood activities. As previous scholarship suggests, though critically important, gender is but one among many factors that shape how rural smallholder households structure their livelihoods (Gengenbach et al., 2018; Rubin & Manfre, 2014).

## Conclusion

The crop portfolios of female-headed households have been linked to higher dietary diversity within households (Jones et al., 2014) as well as to the conservation of agrobiodiversity (Zimmerer et al., 2015); there are thus important reasons to understand gendered differences in crop preferences and how different constraints affect female- and male-headed households in low-income countries. Our findings echo the results of previous studies showing significant gendered differences in crop choices and resource access across multiple contexts in sub-Saharan Africa; the findings presented here also raise questions for future research as market-oriented rural development efforts continue across the region. Consistent with previous studies, our findings suggest that male-headed households have greater access to land for crop cultivation, and also tend towards income-oriented crops more than female-headed households (Bentley et al., 2017; Christinck et al., 2017; Mudege & Walsh, 2016). On the one hand, this may lend support to widely held perspectives that more market opportunities for female-headed households are needed, but on the other hand, these findings may also suggest the gender dynamics that occur as rural agrarian communities shift from a focus on crops for home consumption to more market sales must be carefully monitored. Indeed, as Tavenner et al. (2019) find, the historical patterns and current social norms providing men greater access to input and output markets for commercial crop cultivation

may actually lead to worsening gender inequality in rural communities as crop commercialization expands. Our findings also align with previous evidence that resource-constrained female-headed smallholder households emphasize crops for home consumption more than male-headed households (Pincus et al., 2018). An understudied but important area for future research is the underlying values driving men's and women's choices around crop production. One hypothesis is that with equal opportunities, women's choices would align with men's—in other words, that all smallholders would pursue increased production of market-oriented crops and increased commercialization if they could. A more critical line of inquiry, however,

might question whether women's tendency to produce crops for home consumption is in part due to valuing a diverse crop portfolio that provides for home consumption and conserves locally-preferred crop varieties. As further studies of these important questions are pursued, there will be a need to consider multiple explanatory factors in addition to gender (e.g., access to resources, income, agroecological context, cultural norms), as well as to assess gender dynamics within households (e.g., preferences and constraints of wives versus husbands), in order to understand how agricultural policies and rural development programs may affect women and men farmers. 

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## Appendix A1. Crop Importance for Food Security (Low, Medium, High) by Country and Gender of the Household Head



## Appendix A2. Crop Importance for Food Security (Low, Medium, High) by Country and Gender of the Survey Respondent



## Appendix A3. Crop Importance for Income (Low, Medium, High) by Country and Gender of the Household Head



## Appendix A4. Crop Importance for Income (Low, Medium, High) by Country and Gender of the Survey Respondent

